Jörg Belz, DLR e.V.

How Android can improve blind people's mobility

Research Project InMoBS

"Innerstädtische Mobilitätsunterstützung für Blinde und Sehbehinderte"

(intra-urban mobility support for the blind and visually impaired)

What is DLR?

Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center

@DLR_en

There's more!

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

@DLR_en

Security


Space


Aeronautics

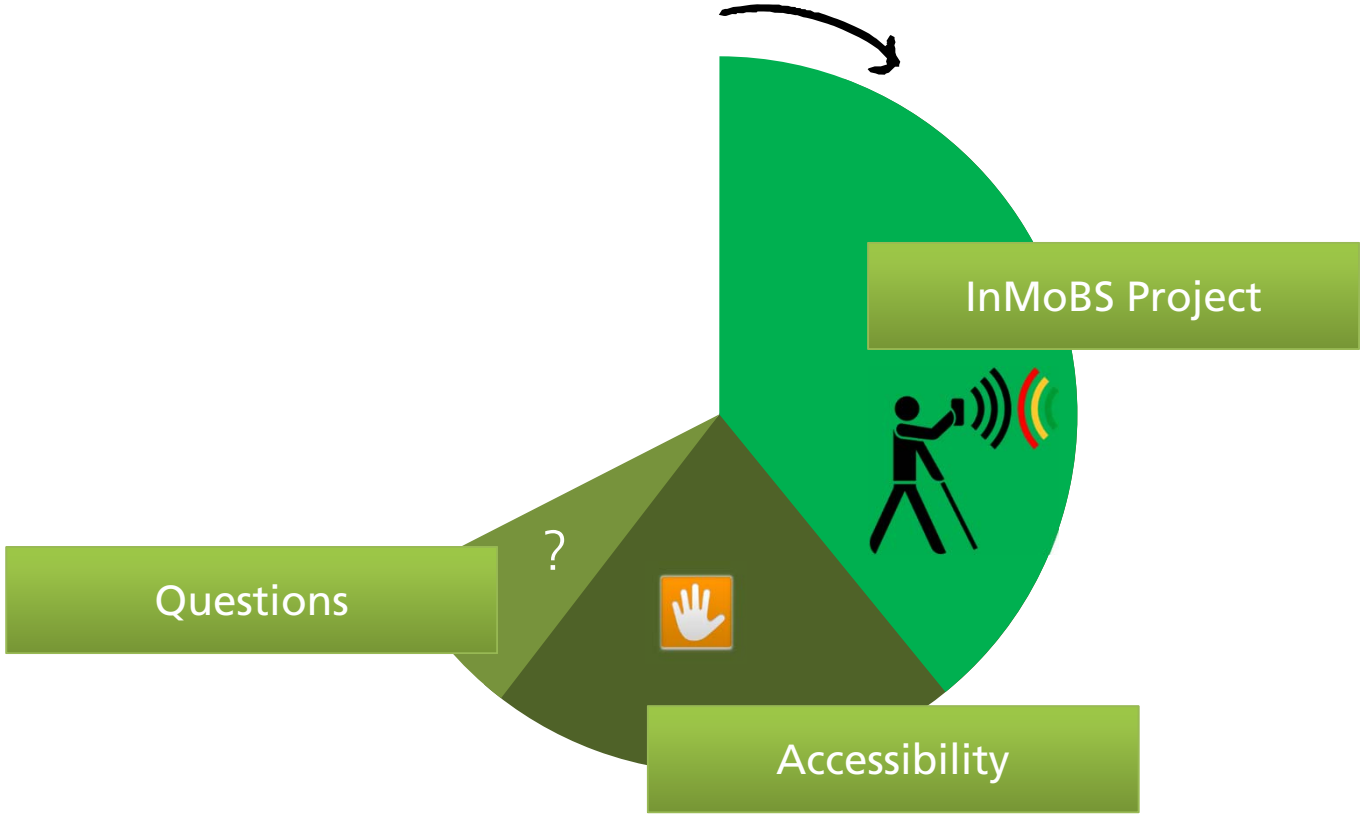

Transport


Energy

Institute for Transportation Systems
→ R&D for
- Automotive
- Railway systems
- Traffic Management
- Public Transport

http://www.dlr.de/ts

Overview



Part I: Research Project InMoBS

Who is InMoBS?

Project duration: 01/2012-12/2014

Project Consortium

Technische Universität Braunschweig · DLR · OECON · SIEMENS · TRANSVER

Funding

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

Subcontractors

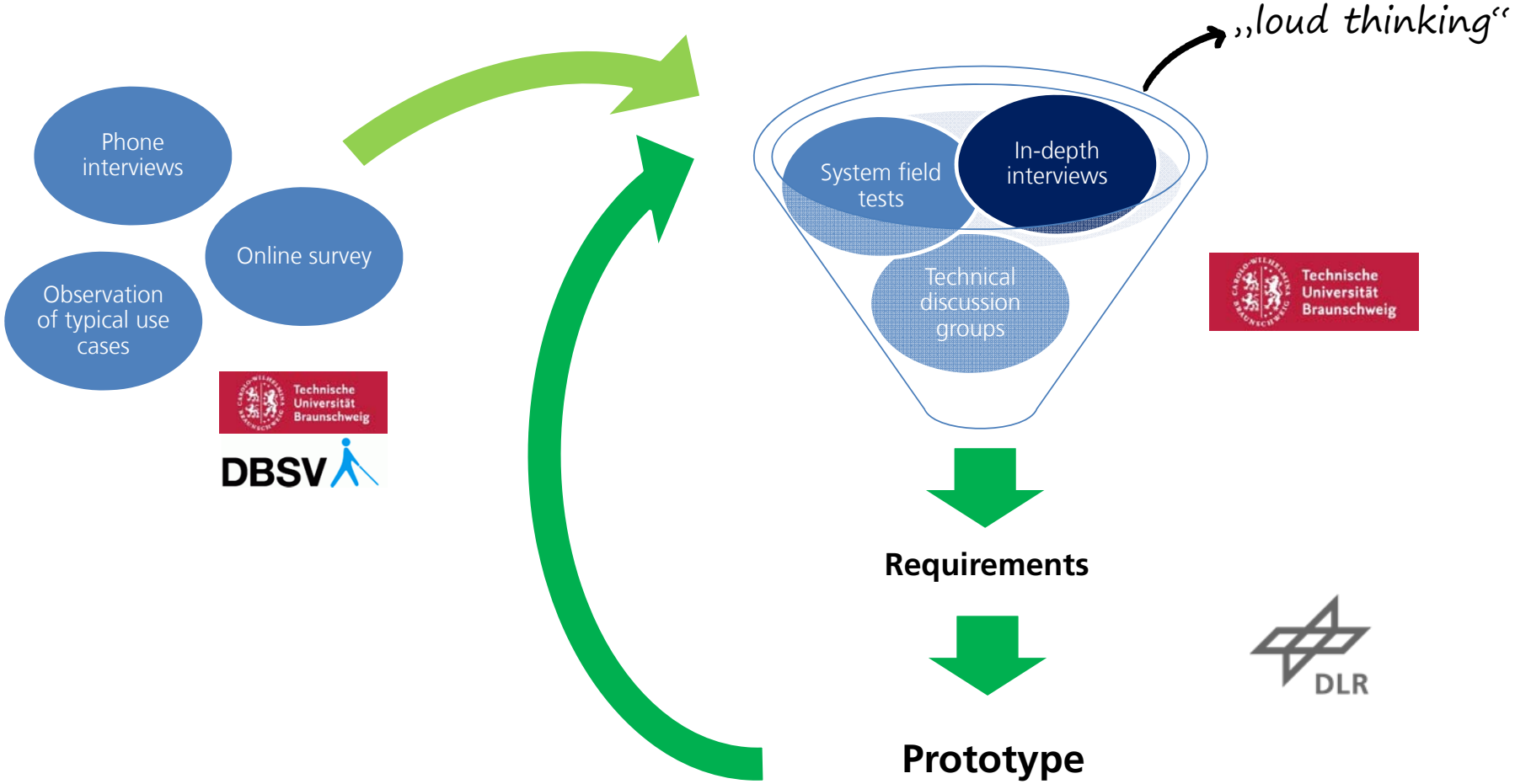
DBSV · ITS Niedersachsen GmbH

German Association of Blind and Partially Sighted

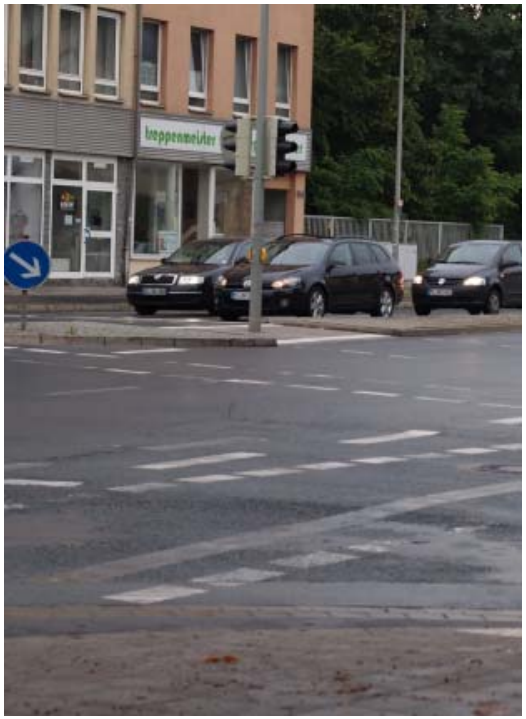
Motivation

http://www.siemens.com/press/en/feature/2014/mobility/2014-12-inmobs.php

Requirements Analysis



Challenges in mobility

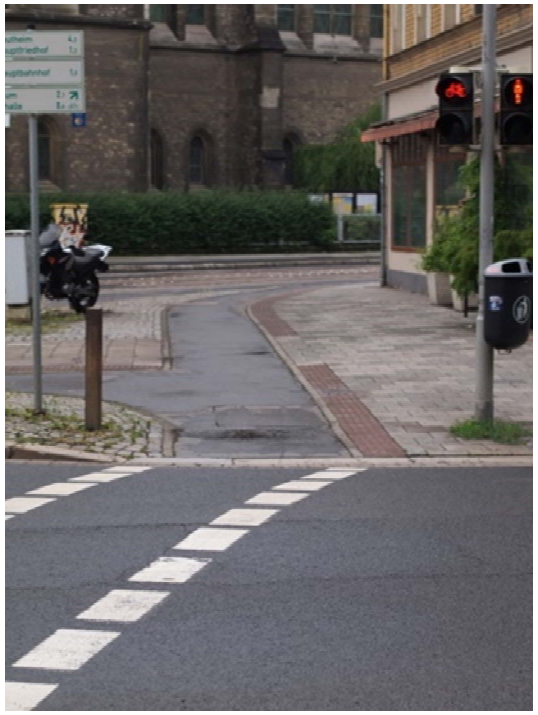


Noisy environment

Unequipped crossings

Unexpected obstacles

Challenges in mobility



Crossing bicycle lanes

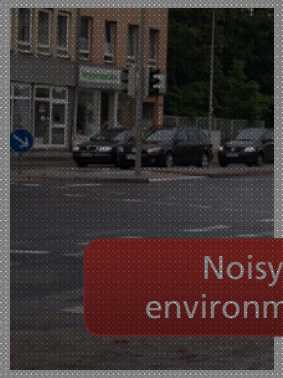
Tripping hazards

Challenges in mobility

Unknown crossing geometry

Lowered Curbs

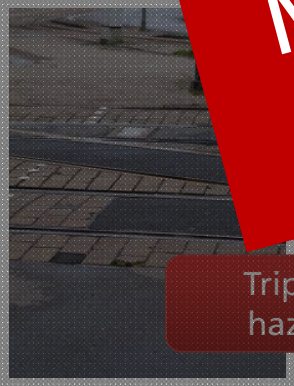
Challenges in mobility



Noisy environment

Unexpected obstacles

Lowered Curbs



Tripping hazards

Mobility often limited to trained / known routes

Major reason: Lack of information

Some information already there…

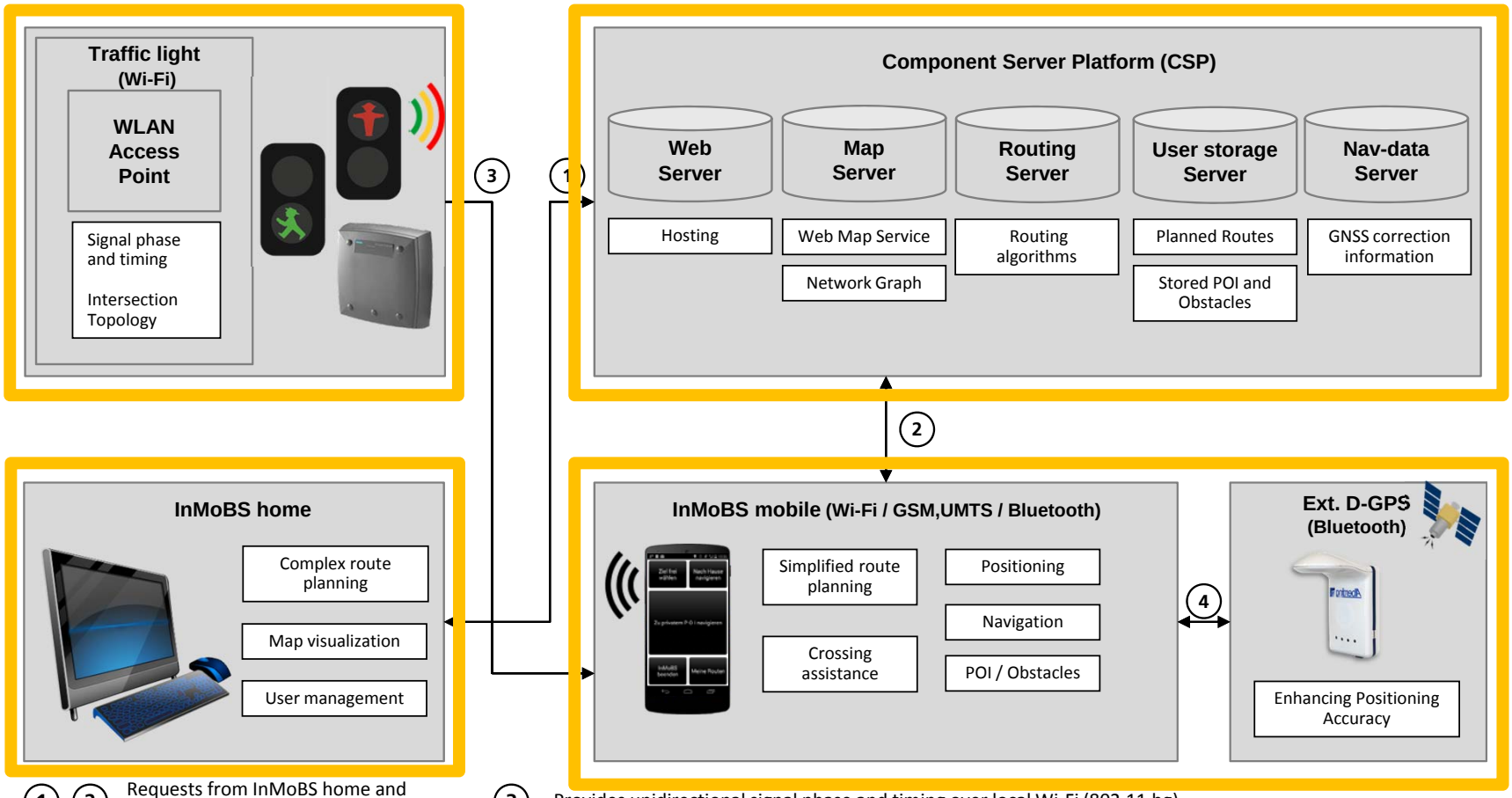
Smartphone app to assist blind and visually impaired in urban environment
(particularly at crossings)

Car2X communication infrastructure

Car2X equipped vehicles
e.g. UR:BAN KOL:NE

AIM: Application Platform for Intelligent Mobility
http://www.dlr.de/ts/en/Portaldata/16/Resources/aim/DLR-TS_ApplicationPlatformIntelligentMobility.pdf

System Overview



1 2 Requests from InMoBS home and InMoBS mobile, provides calculated routes (GeoJson)

3 Provides unidirectional signal phase and timing over local Wi-Fi (802.11 bg)

4 Correction information, provides enhanced position information (NMEA)

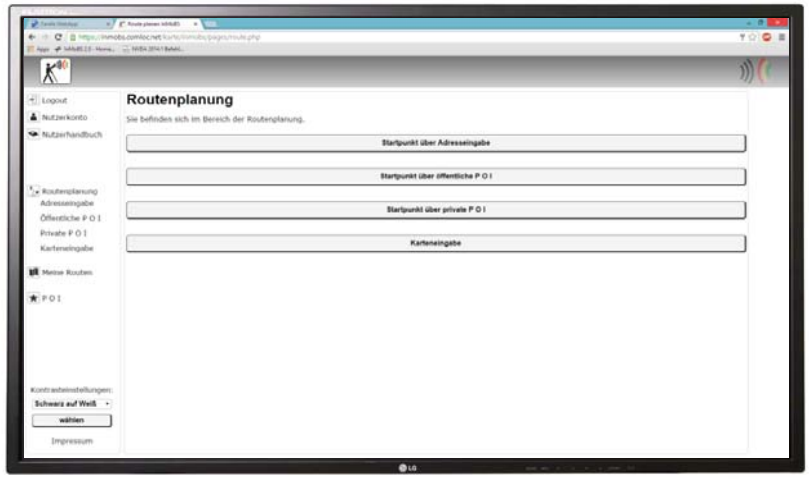
App InMoBS Mobile

- Simple, consistent layout (5 boxes)
- High contrast
- Interaction using Android Talkback (more later)
  - Touch → focus on element, reads description to user
  - Double tap → ‚click' currently focused element, e.g. start new activity

Pretrip

Web portal

- Preplan route at home
- Use of braille terminal possible
- Possibly with assistance from full-sighted person
- Complex route planning possible (e.g. via points)



InMoBS Mobile

- Simple interface
- Choose destination
    - Street / house number
    - Predefined locations (POI)
- Or download route planned using web portal

Main Goals for ontrip navigation

Keep user on route

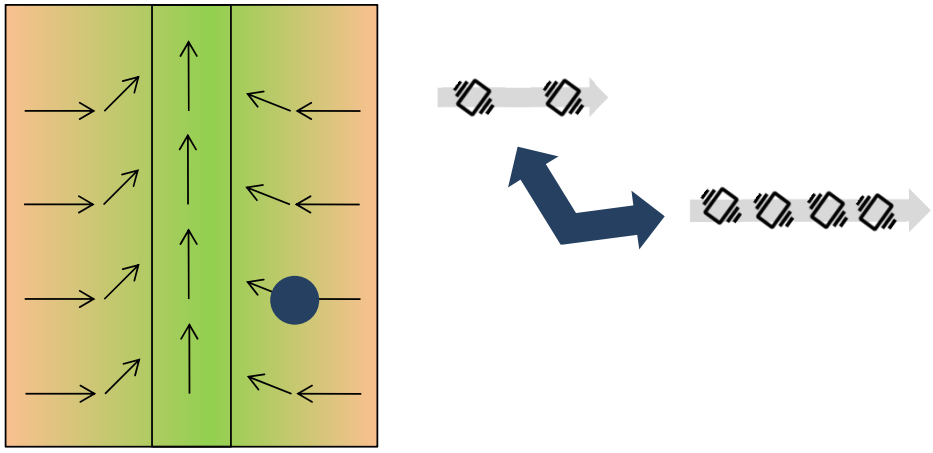
Inform user about surroundings and hazards

Support user at crossings

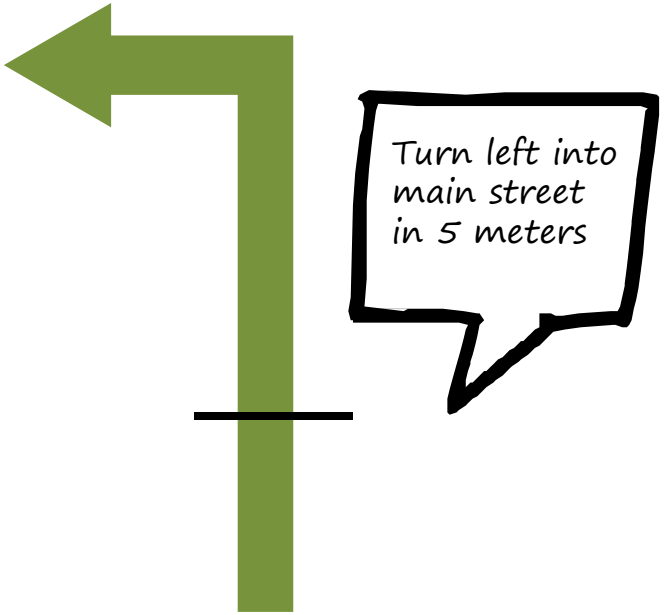
Keep user on route

Constant **guidance** on/to route

- Haptic feedback to keep user on route
- Potential field determines direction
- Right heading – low vibration frequency
  wrong heading – high vibration frequency

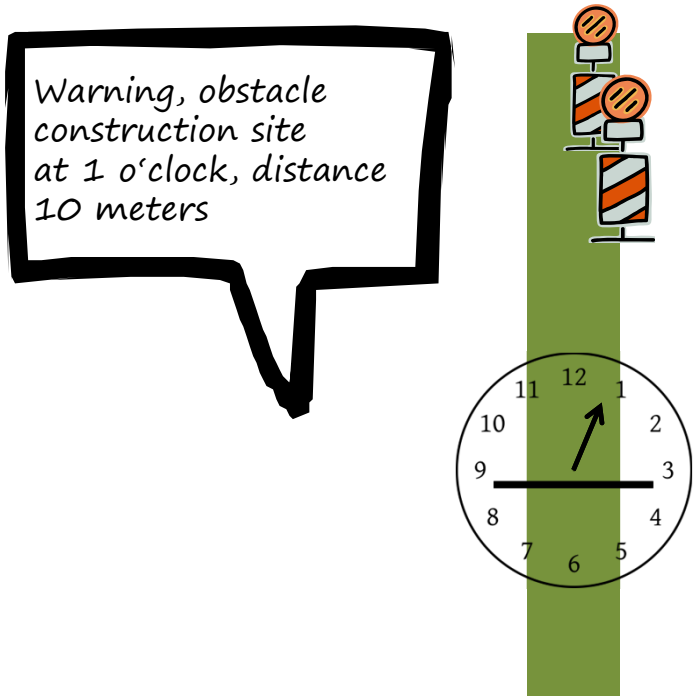


Automatically announce **turns** in advance

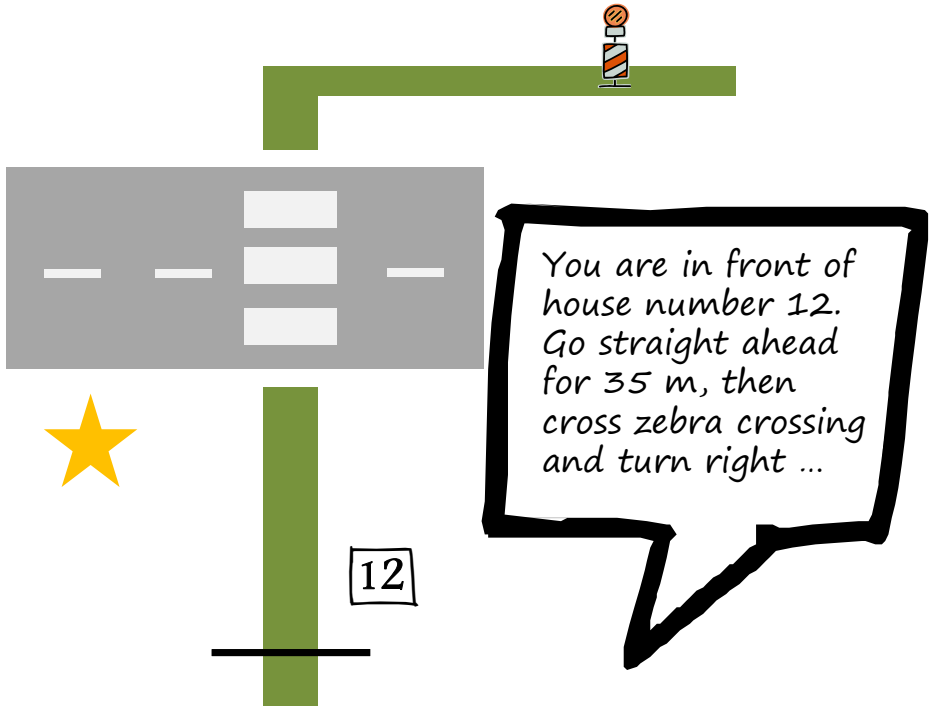


Keep user informed

- *Automatically* announce **POIs and obstacles** on route



- Announce **more information on demand** about position, surroundings and remaining route



Support user at crossings

- Read out detailed information about **crossings**
  - Type of crossing (signalized / unsignalized)?
  - Geometry of crossing (e.g. X / T shaped)?
  - Width of crossing?
  - Push buttons?
  - Tactile/haptic indicators available?
  - Lowered curbs?
  - Tram rail?
  - Traffic island?
  - Crossing bicycle lanes?
  - …
- *Automatically* announce **green signal** on app
  - ETSI ITS G5 Car2X Communication [1][2]
  - Adaption on infrastructure required to support consumer WiFi
  - App connects to infrastructure WiFi, receives SPaT (signal state → red/green) and TOPO (intersection topology → used for determining signal) messages
  - Green signal announced acoustically on change to green

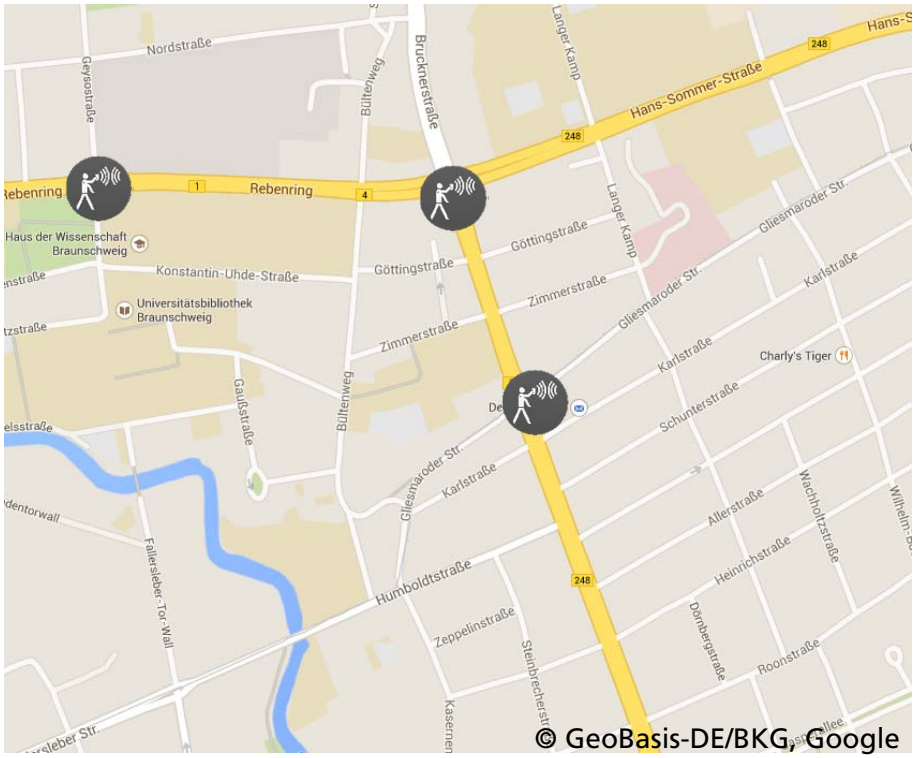
[1] http://www.etsi.org/deliver/etsi_ts/102600_102699/1026360501/01.01.01_60/ts_1026360501v010101p.pdf
[2] http://www.etsi.org/deliver/etsi_ts/102600_102699/1026360401/01.01.01_60/ts_1026360401v010101p.pdf

Evaluation

Prototype evaluated with blind test persons in test site AIM in Braunschweig

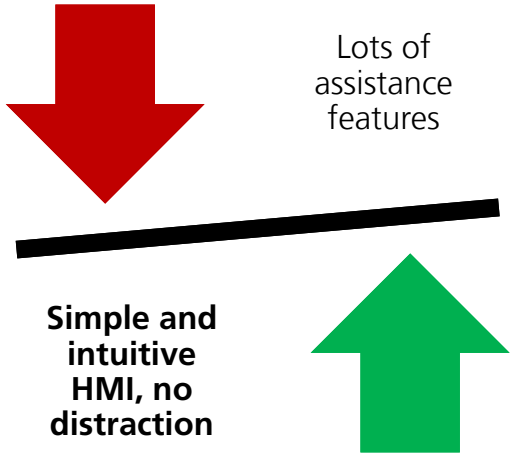
→ Generally positive Feedback

- Good:
  - Useful **information**, in particular at crossings
  - Reliable information about green signal
- Bad:
  - Problems with **positioning**, even when using high precision GPS
- Difficulties in using the app mainly due to **lack of experience** with touch devices



(some of the) Lessons learned from the project

- Balance between simple usability and number of requested features difficult to achieve
- More often than not, simplicity > # features
  - Blind need no complete guidance!
  - Assistance in specific (difficult) situations
  - Automatically triggered announcements are useful, but must be carefully chosen / concise
- Amongst blind people there are also many elderly with no experience with smartphones at all
  → UI as simple as possible
  → Even standard elements such as lists are perceived being complex by some blind users
- Asking blind / visually impaired people to test your app results in extremely helpful feedback



http://www.siemens.com/press/en/feature/2014/mobility/2014-12-inmobs.php

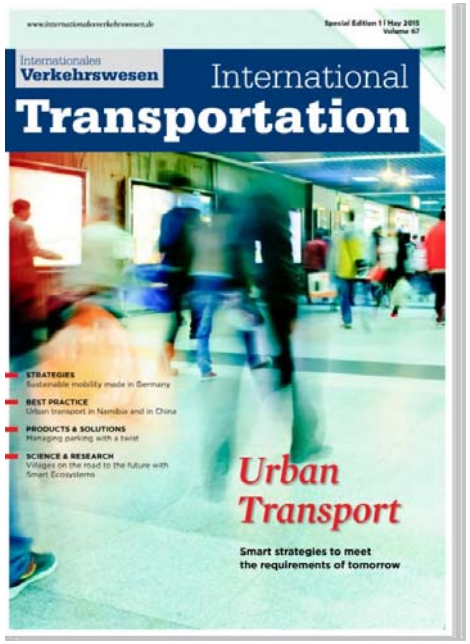
What's next?

- System = Research prototype
  → not available on Play Store
- Improve positioning (+ indoor?)
  → infrastructure?
- Cover larger area
- Include public transport

- Knowledge / results used in other projects
  - e.g. improve safety of vulnerable road users (pedestrians, cyclists) by communicating with cars

More Information

http://www.inmobs.de
(German only)



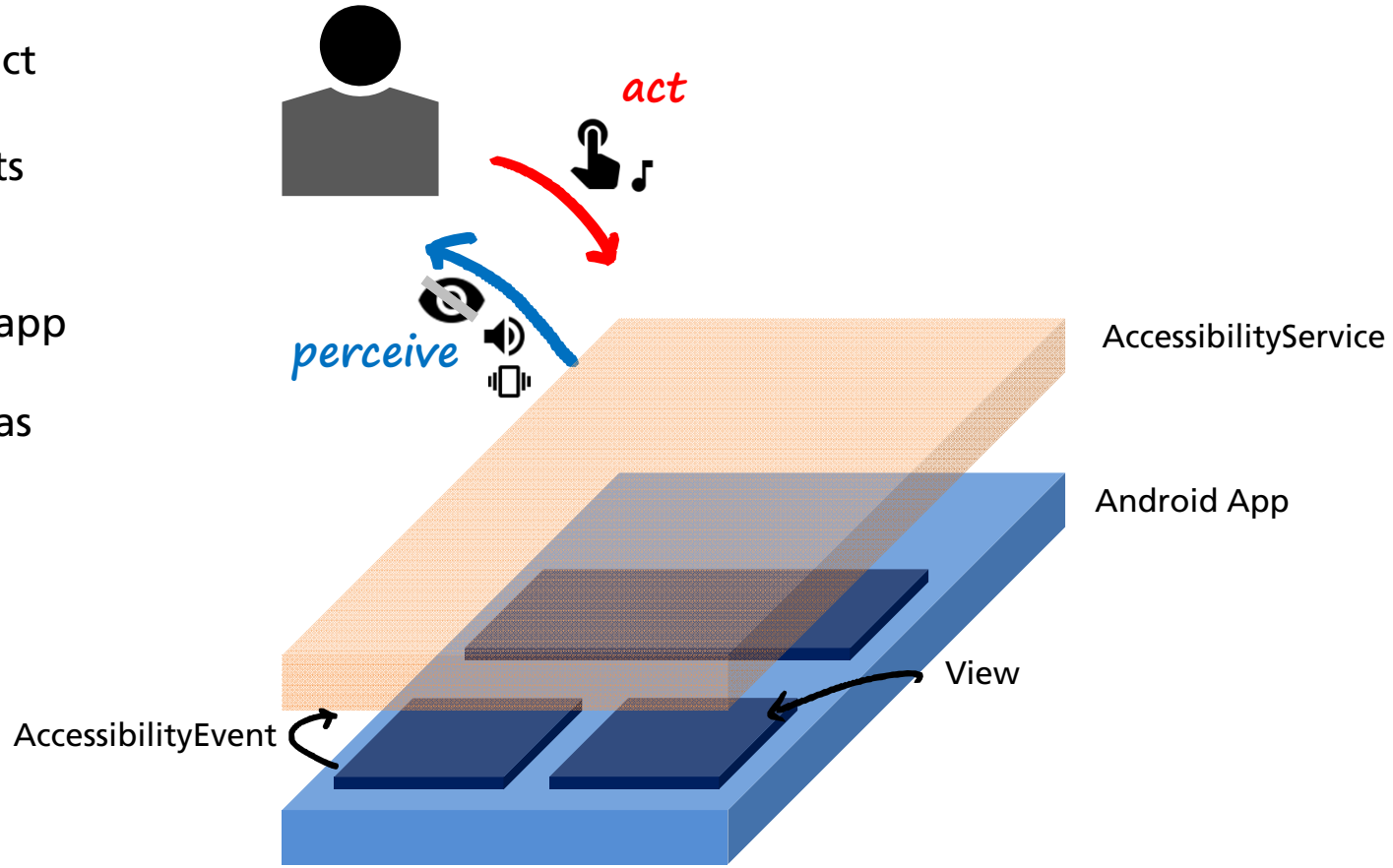
Navigation of blind and visually impaired people
http://www.internationalesverkehrswesen.de/english/special-edition-12015.html

Part II: Accessibility in Android

Accessibility in Android

- User interaction: perceive / think / act cycle
- Visual (or hearing) impairment limits perception
- AccessibilityService
  - intermediate „layer“ between app and user
  - adds additional feedback such as haptic and acoustic cues
- AccessibilityService listens to AccessibilityEvents from Views
  - focus changed
  - content changed
  - View is scrolled

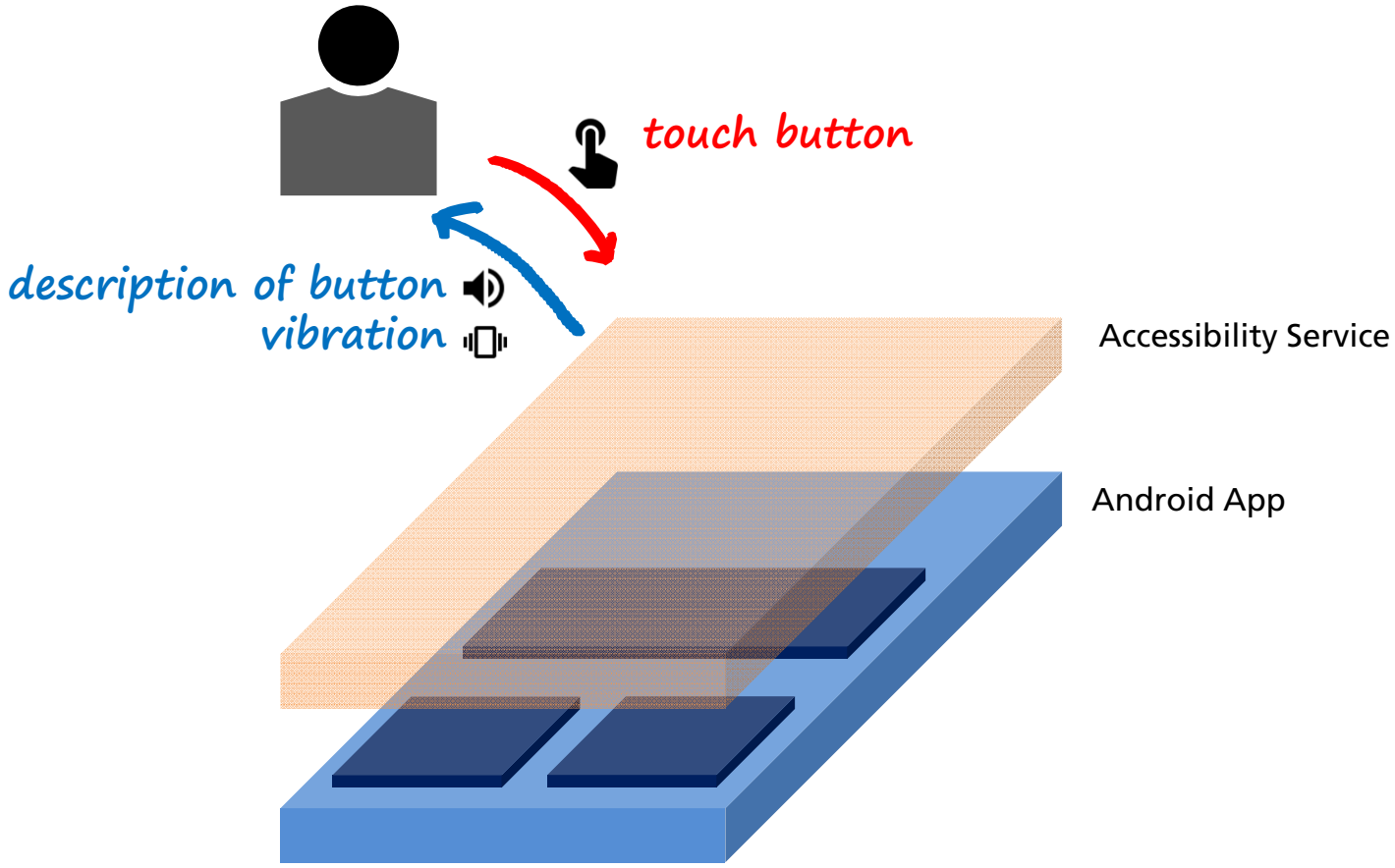
  …



Accessibility in Android

Example: Talkback with Explore by Touch enabled

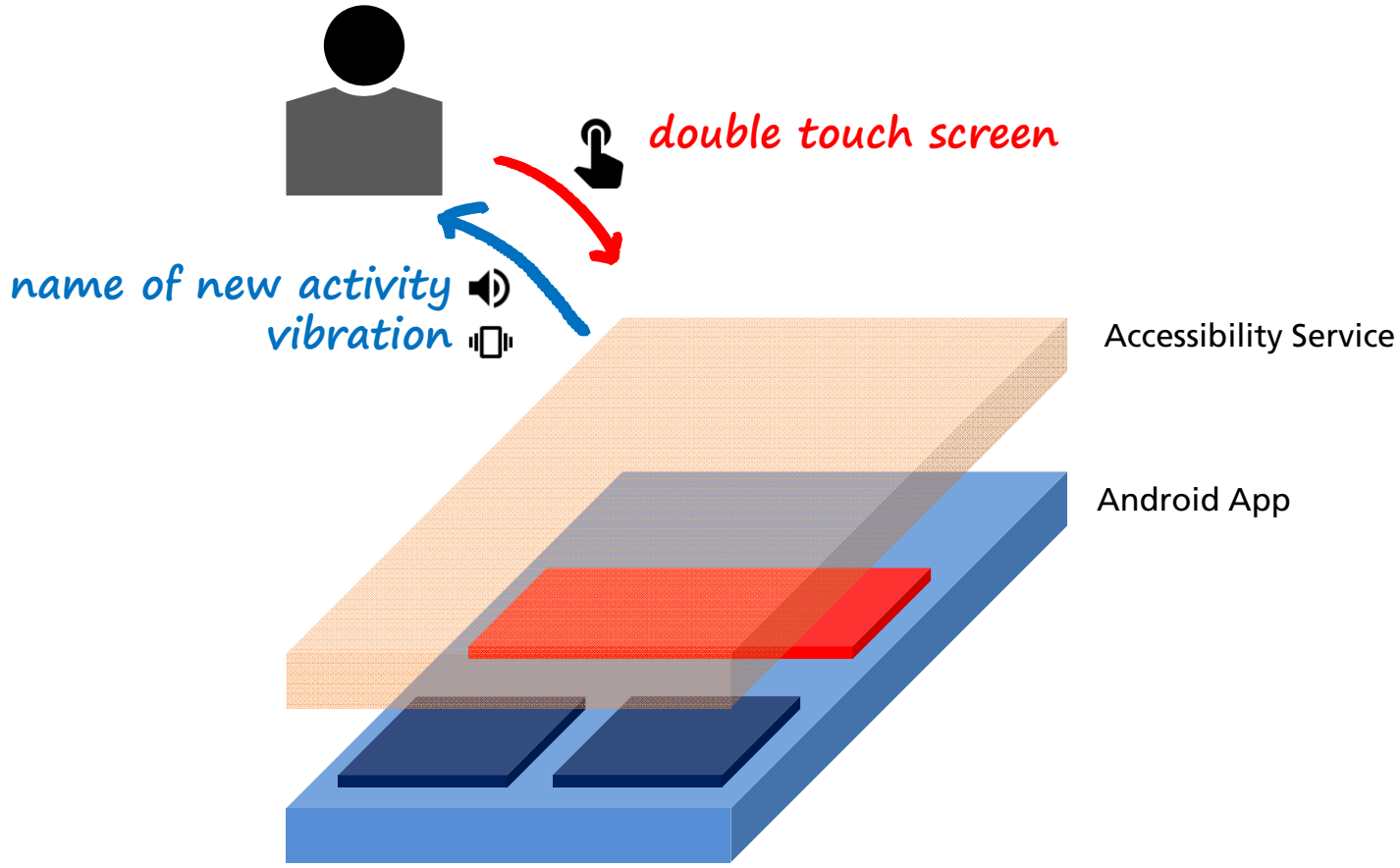
- Single touch → focus on element, reads description to user



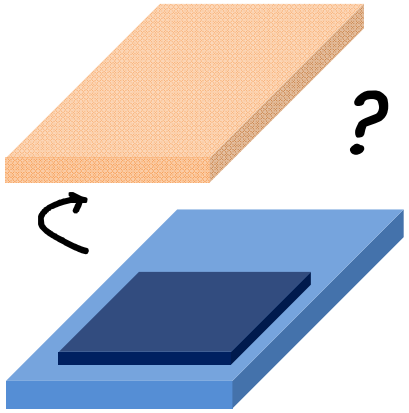
Accessibility in Android

Example: Talkback with Explore by Touch enabled

- Single touch → focus on element, reads description to user
- Double touch → ‚click' currently focused element, e.g. start new activity



Accessibility in Android



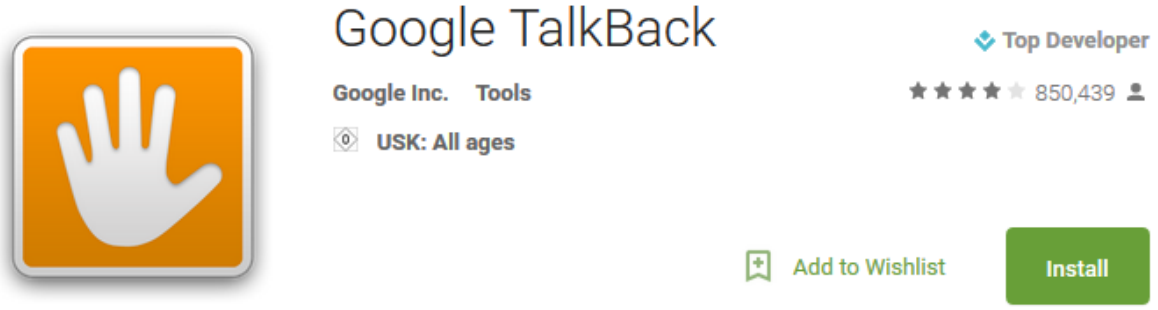
Good News I:
AccessibilityService has already been implemented for you: Google Talkback

Good News II:
Standard Android Views already work together with Accessibility Services

So what is left to do?

Accessibility in Android

Enable Talkback on your device and try it out for yourself



Talk back gestures:
https://support.google.com/accessibility/android/answer/6151827?hl=en

Accessibility in Android

Use ContentDescriptions to label non-text or custom views (Icons, Imagesbuttons, …)

(they're like HTML alt-tags)

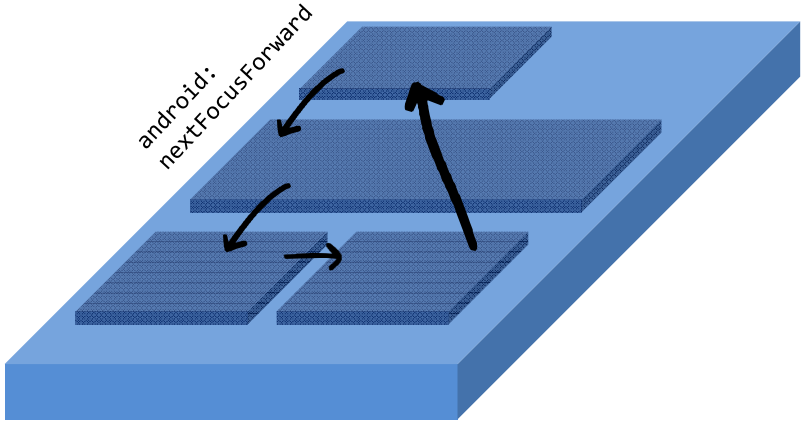
```
<Button
        android:id="@+id/pause_button"
        android:src="@drawable/pause"
        android:contentDescription="@string/pause"
/>
```


Accessibility in Android

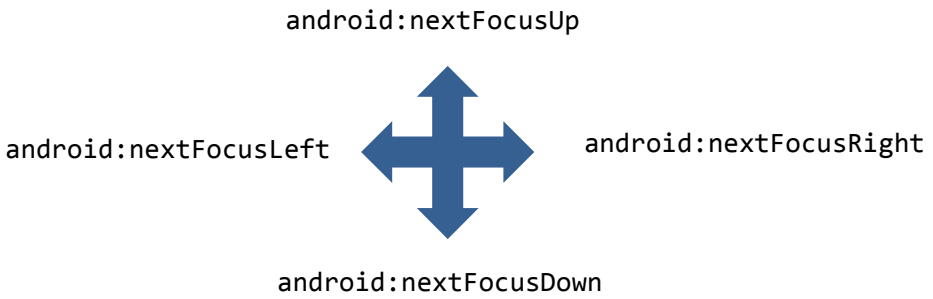
Set an explicit view focus navigation order

(there's a default focus order, but may not make sense for your app)

AccessibilityServices can enable users to iterate through focusable views



Users can also switch between elements using keyboards [software/hardware]



https://developer.android.com/training/keyboard-input/navigation.html

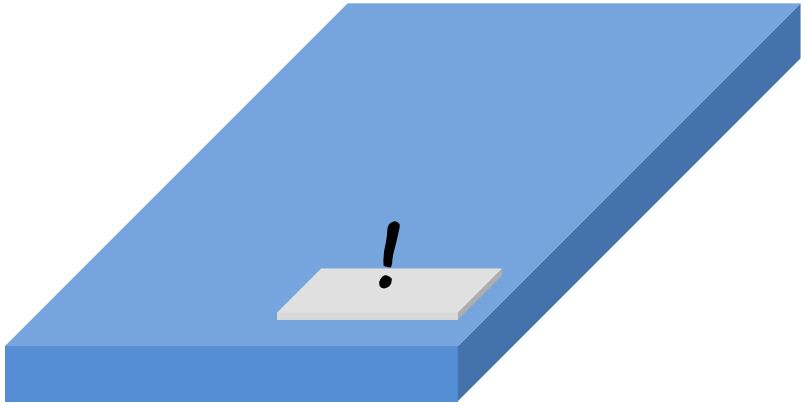
Accessibility in Android

In your custom views, send AccessibilityEvents so the AccessibilityService can support the user

```
sendAccessibilityEvent(
AccessibilityEvent.CONTENT_CHANGE_TYPE_TEXT);
```


Accessibility in Android

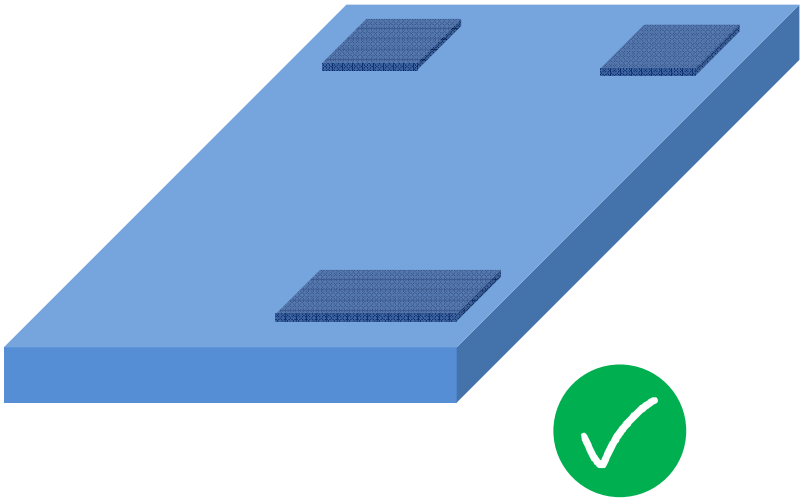
Notify users about important changes in views



`android:accessibilityLiveRegion` → none / polite / assertive

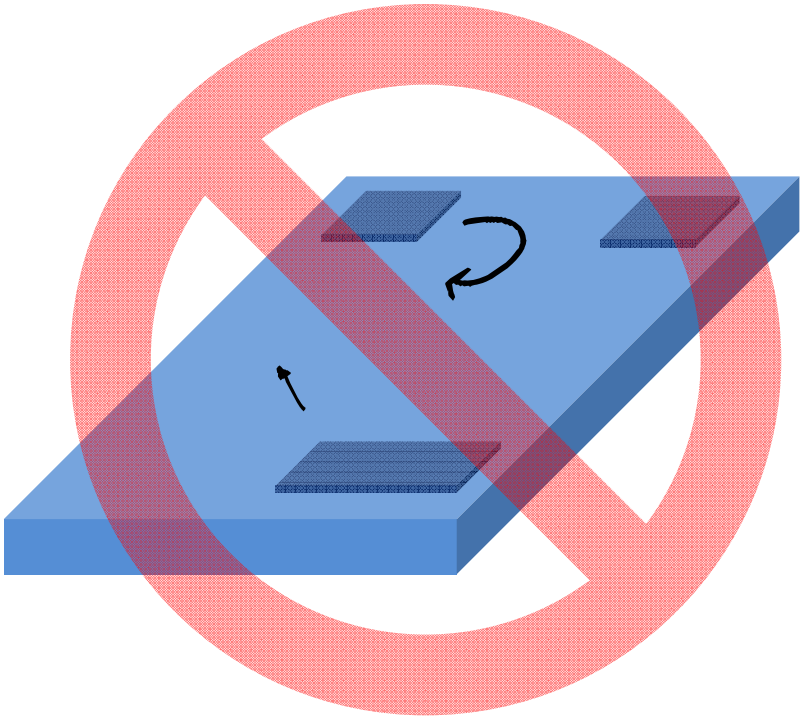
Accessibility in Android

Make touch targets sufficiently large (>= 48 dip)



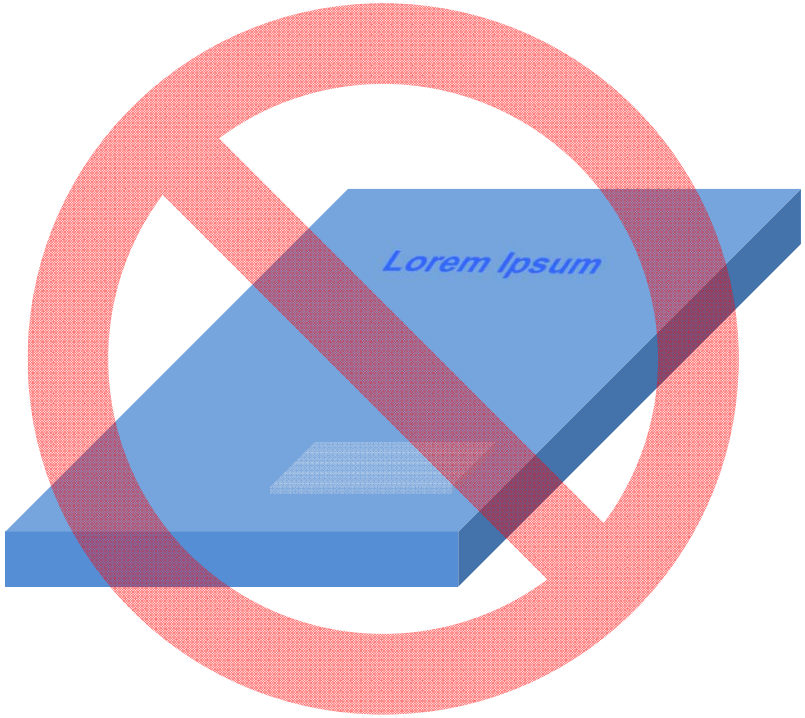
Accessibility in Android

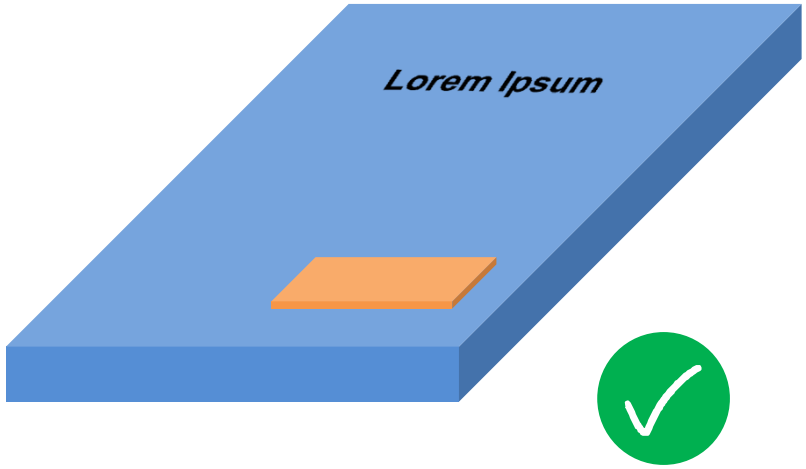
Use a consistent layout without too much dynamics



Accessibility in Android

Avoid low contrasts





Accessibility in Android

Read the well-written guidelines
(where I got most of this information myself)

https://developer.android.com/guide/topics/ui/accessibility/checklist.html
https://developer.android.com/guide/topics/ui/accessibility/apps.html
https://developer.android.com/design/patterns/accessibility.html
https://docs.google.com/presentation/d/18ZUiXTZIGx0ydeLcKxnp5BxnI5kv7Cxm6rPaTf-c0ms/pub

Take home message

- Fact: There are potential users with visual or other physical impairments for your app
- Often, a few simple steps (like ContentDescriptions) can make you app much more usable by them
- … and also to everyone else (like inexperienced users or elderly)

Jörg Belz
joerg.belz@dlr.de
Institute for Transportation Systems
DLR e.V.